

Technological Substitution in Publishing

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Introduction

Information technologies (hardware and software) are playing a key role in innovations in industry after industry. They diffuse through an industry by improving procedures, processes and products. The diffusion usually begins with incremental changes aimed at improving costs, or more broadly, efficiency. This is like a virus infecting a living cell, the informed or informatized (we don't have good language to describe the result) is transformed into something new. Informed segments of the economy then multiply their effects on the industry radically changing it or destroying it.

The publication industry is one of the industries being so affected. Information technologies have found their way into the processes of printing books, their distribution, the way they are sold, and even the way we communicate about the books. Now information technology is altering the very nature of publications, especially in the textbooks and supplemental materials used in K-12 education. And, now the information technologies developed to aid social change and societal development have begun to impact the industry, threatening to destroy it.

This article summarizes the meta research done on the industry searching for data that indicates the nature and rate of substitution of information technologies into print. There are two overall conclusions from this study. First, that there are indications of the substitution going on in a number of areas. And, second, that we lack a coherent set of data on the industry that would enable us to make firm predictions.

Substitution analysis is a well accepted method of technological forecasting in use for 36 years. In these analyses, the Fisher-Pry model was used. The Fisher-Pry model predicts characteristics loosely analogous to those of biological system growth. It results in a S-curve (more formally, sigmoidal curve) familiar to many because the curve is in the shape of an S. These natural growth processes share the properties of relatively slow early change, followed by steep growth, then a turnover as size asymptotically approaches a limit.

Reference Library

Substitution analysis is a powerful tool to examine and forecast the substitution of one technology for another. In this case, the substitution is electronic media for print media in the reference library. The surrogate data that we have is that provided by Association of Research Libraries. It is not the complete world of expenditures on reference materials for libraries, but it is representative, at least of the big libraries. The data that ARL provides is a measure of expenditures. This is a useful surrogate for the number of units, the number of users or the amount of material, all potentially more direct measures of the substitution. However, sales



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figures are quite often used as they provide an aggregate way of indicating the impact of the new technology on the market.

It is also important to note that there are multiple substitutions going on in a cascade of change from print - CD, LAN and Internet, to just name a few. If data were available on this level of detail, a multiple substitution model could be created.

The Fisher-Pry substitution model is often used to analyze a substitution like electronic for print media in the reference library. The relationship between the fraction of total market taken by the new technology, f , is often given as:

$$f = 1 / (1 + c \exp(-bt))$$

where t is time, and c and b are empirically determined coefficients. In this case b and c were determined from the data provided by Association of Reference Libraries for the years 1992 to 2004.

When these data are analyzed utilizing the Fisher-Pry method, the graph shown in Figure 1 results. It clearly indicates that the substitution of electronic for print is well underway in reference materials. The crossover point will occur in 2008 and 90% substitution will be achieved ten years later.

Taking 1990 as the beginning of the substitution, and the middle projection, the time to 90% substitution by electronic media will take 28 years.

One of the interesting, and most insidious aspects of this type of substitution, when the substitution is taking place in a growing market, is that a large percentage of the substitution has taken place before the old technology sees two successive years of decreased revenue. This is the case here as well. Fifty percent of the total time to 90% substitution has elapsed before the print media have experienced two years decline, as shown in Figure 2.

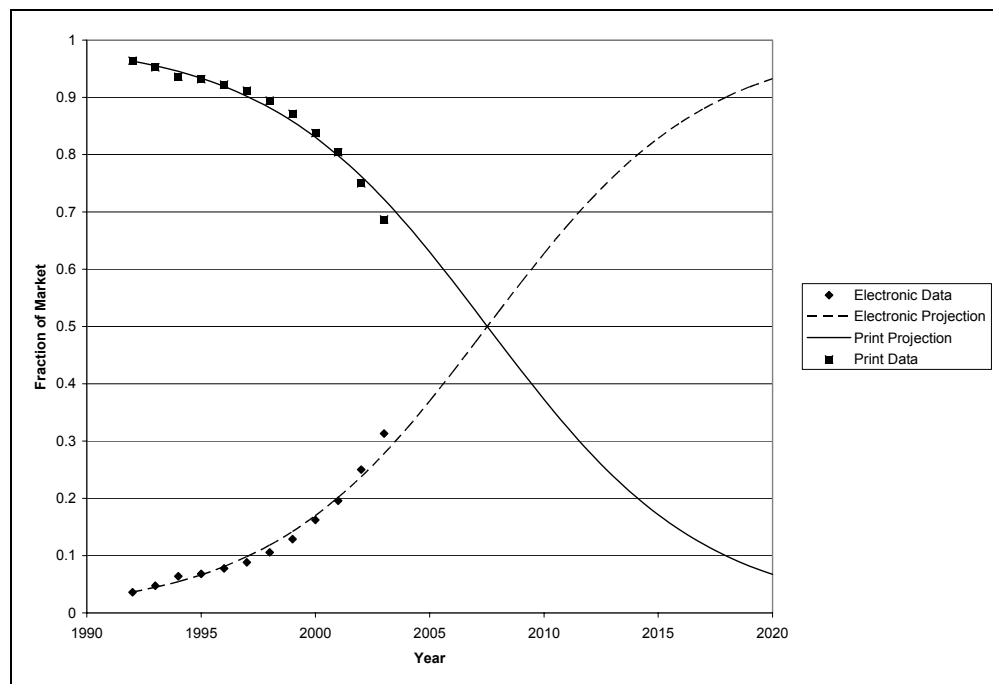


Figure 1. Data: <http://www.arl.org>

There is an additional substitution going on and that is collaborative user generated content for traditional organized, hierarchical development and production. The reference industry is a pioneer in this substitution in Wikipedia. This is a substitution within the electronic reference resources, and unfortunately we have no data to indicate how this substitution is progressing. Revenue is not a good surrogate for this type of substitution as the results of the Wikipedia effort are available for free. The only possible measure would be the number of accesses or amount of time that people use Wikipedia versus other traditional reference resources. Wikipedia is certainly growing fast (Figure 3), in spite of professional criticism of the quality of the effort. Figure three indicates the growth in the number of English articles. The number of English articles is projected to be:

2007: 1.7M

2008: 4M

2009: 8.5M

2010: 18M

The transformation of the reference library has not been completed. There are many factors, trends and driving forces that could affect the future of the reference library. I think that the two most important trends affecting the future of the reference library, and by association, the reference publishing industry are: search engines vs. indexed collections, and proprietary vs. open content creation.

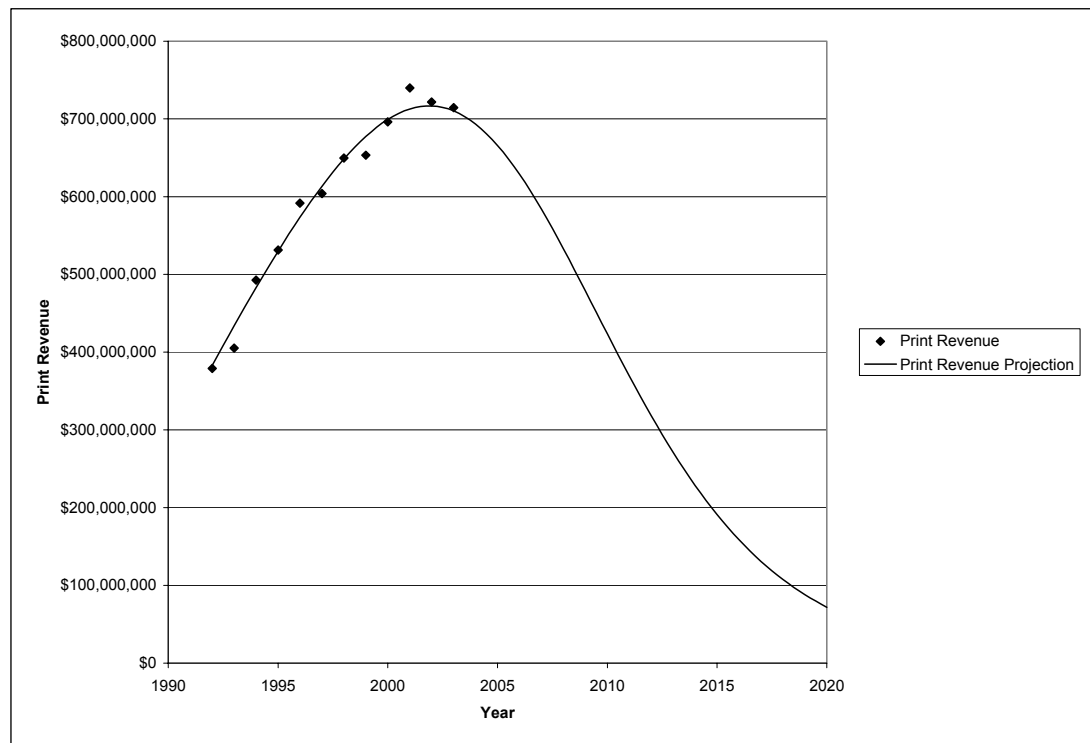


Figure 2.

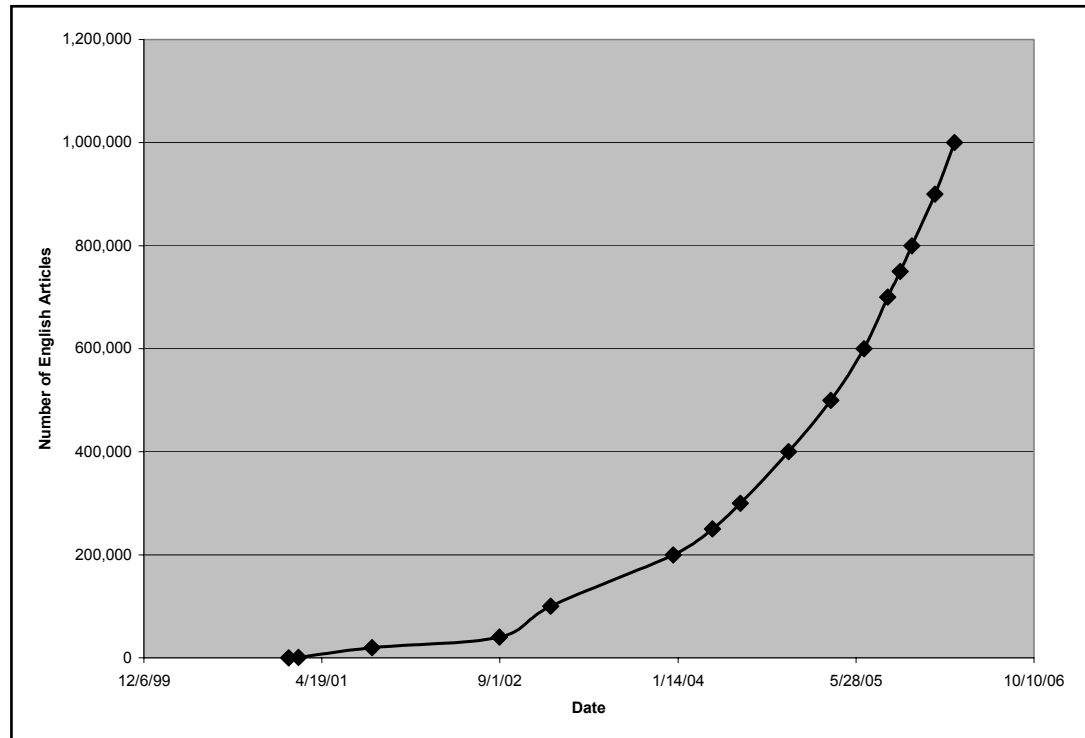
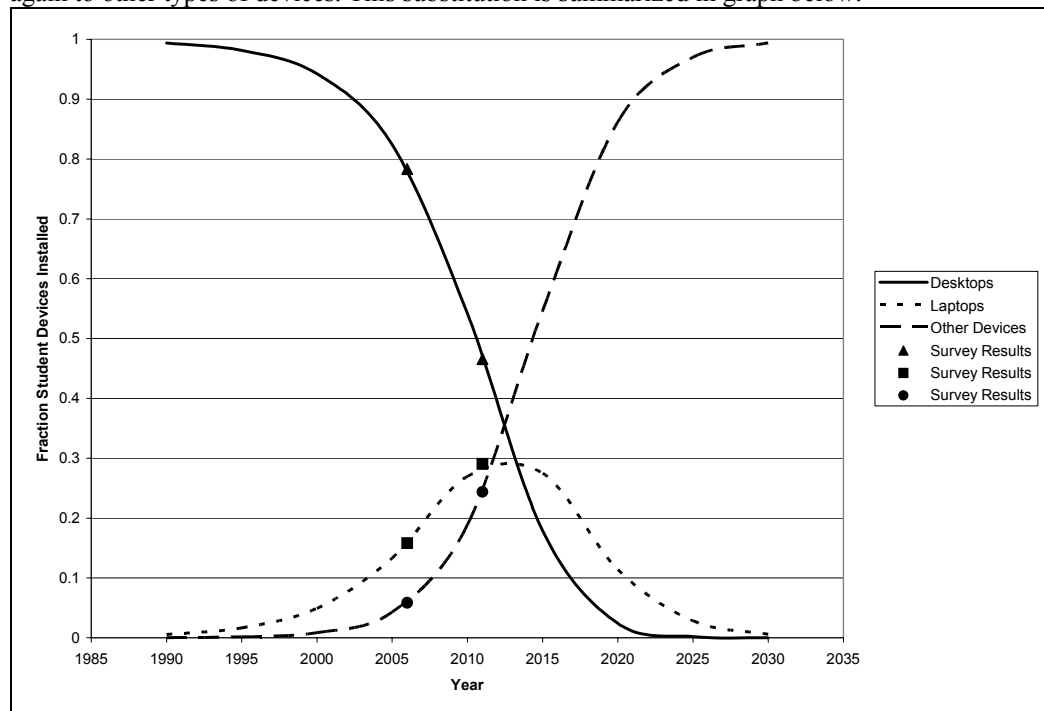


Figure 3. Source: Wikipedia

Student Device Technology

Student devices have changed from desk top to lap top over the years, and are now changing again to other types of devices. This substitution is summarized in graph below.

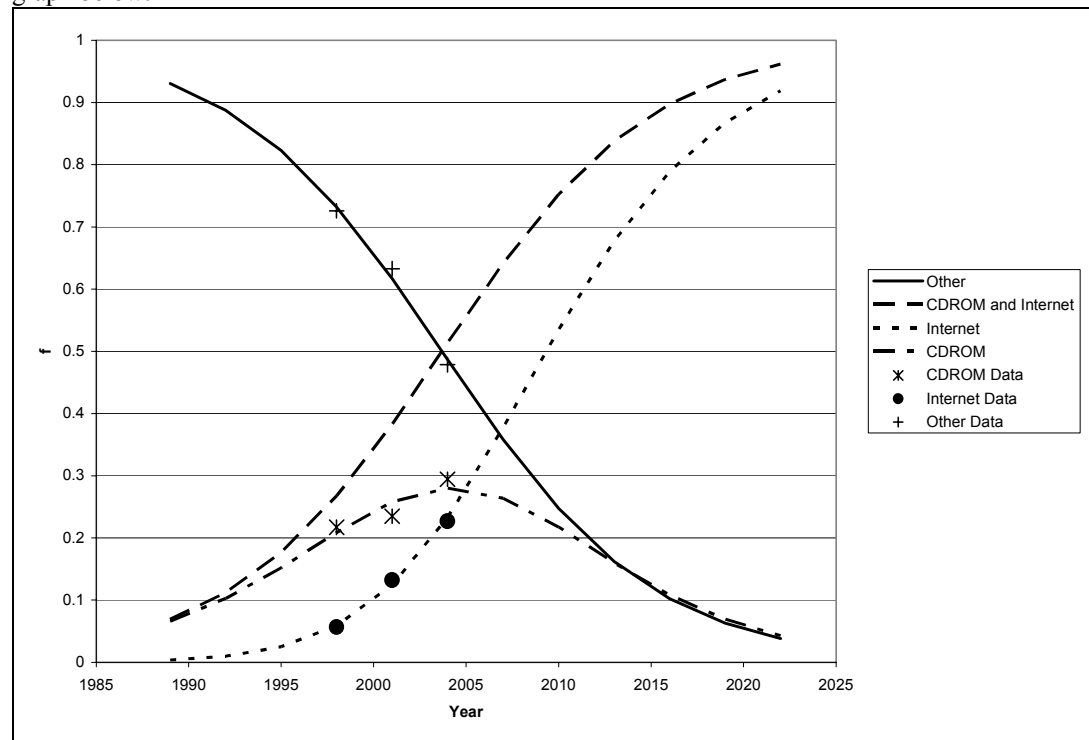


Data: America's Digital Schools, The Greaves Group & The Hays Connection, 2006

While the number of data points is small, the data fits the Fisher-Pry model well, and supports common knowledge. Desktops are in decline and laptops have reached their maximum penetration of the market. Other types of student devices are rapidly gaining share of the market. While there is data presented in America's Digital Schools on a number of other student devices, with the limited number of data points, it was impossible to segment the other device category. However, thin client, handheld, cell phones and portable gaming devices seem to be on the decline. While, tablet PCs and student appliances are gaining market share.

Supplemental Instructional Materials

In "A Study of the Grade K-6 Supplementary Instructional Materials Market", the authors use instructional time used as a measure of the penetration of various materials and technologies. This is a much better surrogate measure of the penetration of new technologies and concepts into the market as it doesn't depend upon the cost of the technology or material. (This approach should be the basis for a thorough study of the substitutions ongoing in the education arena.) However, the data is limited. What it does show is that CDROM and the Internet are gaining share of instructional time at the expense of other media, as shown in the graph below.



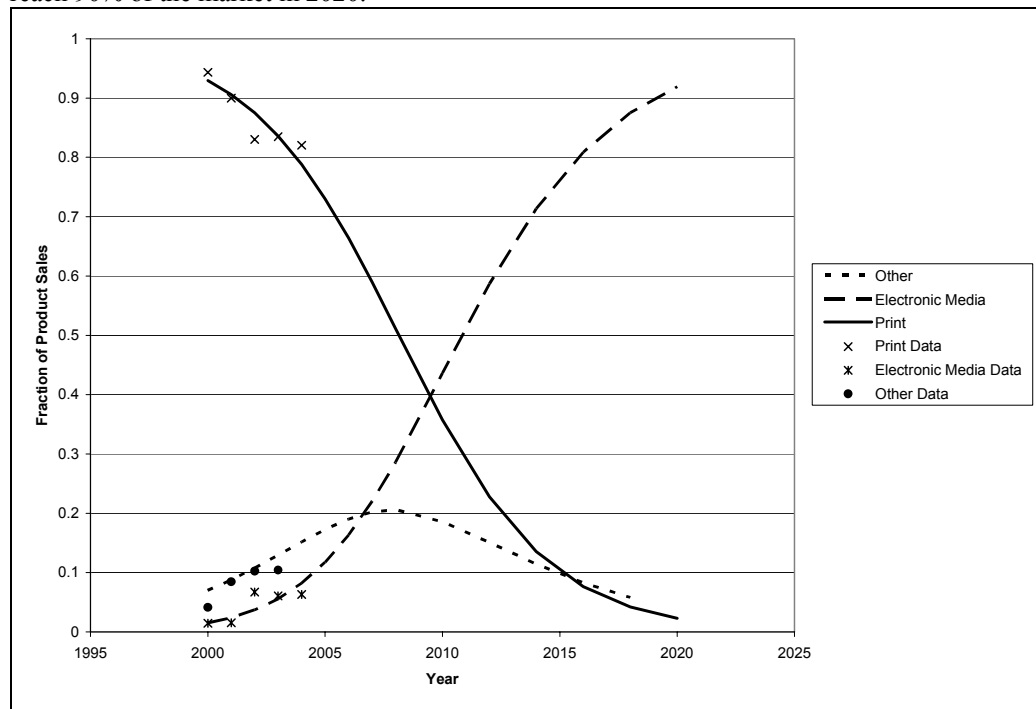
Data: Study of the Grade K-6 Supplementary Instructional Materials Market, Hagen Marketing Research Inc., Lois Eskin Associates & Professional Publishing Services, 2004

Ultimately, it appears that the Internet will be the primary method for computer based instructional delivery.

Supplemental Products

The educational supplemental products market is fragmented and complex. However, at a very high level it is possible to discern substitutions that are occurring. Print based supplemental products are in a steady decline. Other forms of supplemental products while increasing for a while, never gained a large market share and are now beginning to decline in

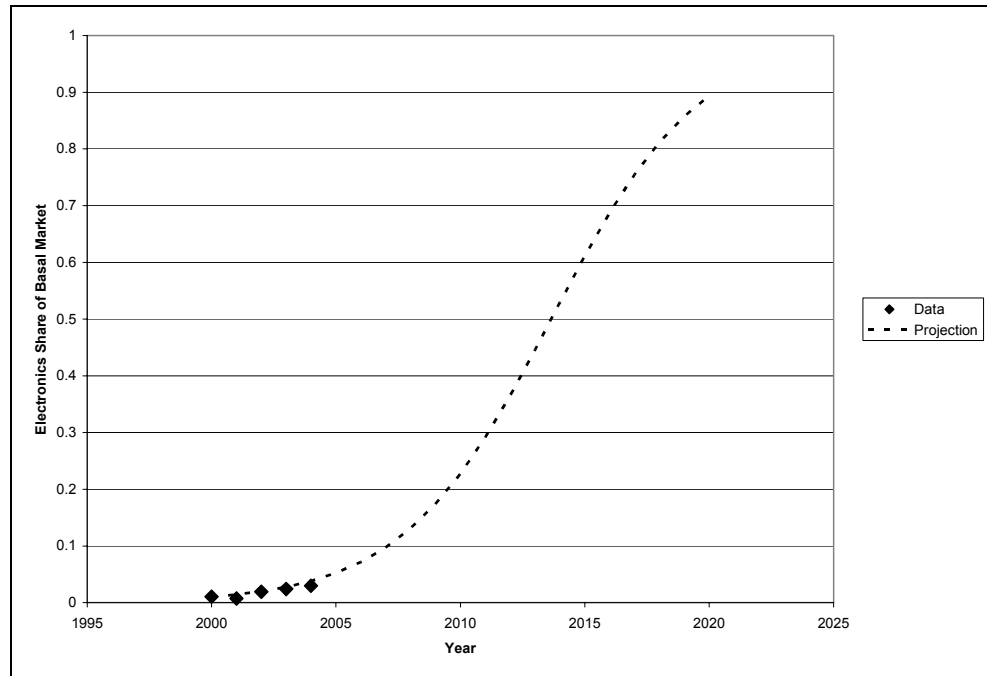
market share. Electronic media based supplemental products are steadily increasing and will reach 90% of the market in 2020.



Data: Association of American Publishers, 2004

Basel Products

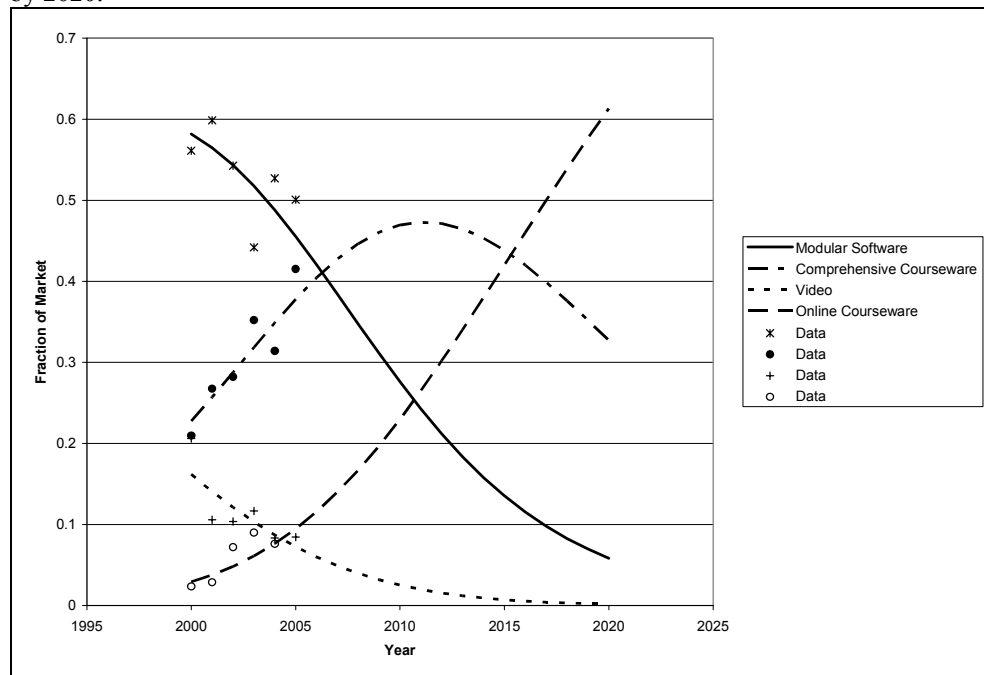
It would appear that the electronic substitution for print in basal education products has begun. While the data indicates that the substitution is in the early stages, it does seem to indicate that it has begun. The data source for this is suspect as it is the results of two surveys without guarantee that the two survey populations were representative samples. Research in the field of substitution analysis generally agrees that if the substitution reaches 5%, the substitution models are accurate



Data: Association of American Publishers, 2004

Electronic Media

There are multiple substitutions occurring within the media for K-12 classroom instruction. Modular software and video are losing market share. Comprehensive courseware is gaining market share now, but will reach its peak of market share in about 2010, and then begin to decline. Online courseware is gaining market share now and will reach a penetration of 60% by 2020.



Data: The Complete K-12 Report, Education Market Research, 2006, 2005, 2004, 2003, 2002 & 2001

Other Considerations

Without a comprehensive study of the usage of educational materials in the K-12 classroom, it is going to be impossible to detect and understand the changes in education that are already underway. Three major substitutions have already begun that we can't detect with traditional market reports based on sales:

1. New theories of learning: See for example the connectivism movement of George Siemens at the University of Manitoba (<http://www.connectivism.ca/>) and the recent book *Presence* by Senge, Scharmer, Jaworski and Flowers in which learning is based on the future rather than the past.
2. Utilization of social technologies: See for example *Blogs, Wikis, Podcasts, and Other Powerful Web Tools for Classrooms* by Will Richardson and the Learning Technologies Center (<http://ltc.umanitoba.ca/wiki/>)
3. Collaborative User Generate Content: See for example Wikipedia (www.wikipedia.com), Wikibooks (www.wikibooks.com), the Open Content Network (www.open-content.net) and the generalized interface for instructional modules (SCORM)

"Open" content is developed through a collaboration of volunteers who care enough about the subject that they devote their minds and resources to create something of value. A current example of open content creation is Wikipedia.

Derek Keats writes in "Collaborative Development of Open Content":

"A number of organizations are active in the open content area. OpenContentList is a site and mailing list covering the field of Open Content: emerging models of collaboratively-built content, from Weblogs to user-run encyclopedias to free media databases. The Open Content Network aims to be the world's largest content delivery network (CDN). Its Web site claims that users will soon be able to download open source and public domain software, movies, and music at incredibly fast speeds from this global, distributed network. The Open Content Network is based on peer-to-peer technology, called the "Content-Addressable Web", which enables advanced content location and distribution services for use with standard Web servers, caches, and browsers.

There are two open content online encyclopedia projects that are fairly mature, Nupedia and Wikipedia. Both projects were initiated by Larry Sanger, with Nupedia being a formal peer-reviewed project, and Wikipedia being much more open and less formal. Both Nupedia and Wikipedia are originated and hosted by Bomis, a WebPortal company. Nupedia has been under development for some time and still has a very limited number of articles. It relies completely on volunteers to create content, and articles are written by individuals rather than interacting teams of collaborators. Judging by the Web site, Nupedia is yet to achieve the momentum needed to make the project a success. Wikipedia started in January 2001 and as of November 2002 claimed to be working on 93,345 articles in the English version. Anonymous users are able to change content, but despite this there are some surprisingly good articles. Like Nupedia, Wikipedia relies completely on volunteers but articles are more of a community effort since anyone can make corrections."

From "About Wikipedia":

"Wikipedia is a free-content encyclopedia, written collaboratively by people from all around the world. The site is a wiki, which means that anyone can edit articles simply by clicking on the edit this page link.

There are 13,000 active contributors working on over 1,800,000 articles in more than 100 languages. As of today, there are 793,168 articles in English; every day hundreds of thousands

of visitors from around the world make tens of thousands of edits and create thousands of new articles to enhance the amount of knowledge held by the Wikipedia encyclopedia. Visitors do not need any special qualifications to contribute, and people of all ages help to write Wikipedia articles.

All the text in Wikipedia, and most images and other content, is covered by the GNU Free Documentation License (GFDL). Contributions remain the property of their creators, while the GFDL license ensures the content will remain freely distributable and reproducible."

It appears that in the future, many reference works will be both free and open. This trend will accelerate the decline of the printed reference industry, and may mean the same for the proprietary electronic reference industry unless that industry can determine how to participate in the free and collaborative information trend.

Not only is this trend well underway for the reference publishing industry, it has started in the textbook industry as well. A recent conference "Reconsidering the Textbook: and an article on that conference "The Future of a Dinosaur" are good places to begin an understanding of this trend. The same type of trend is also apparent for scientific and technical journals.

An enabling technology for open content development is SCORM, described in an article by Robert Brumfield in "Gathering SCORM Could Transform eLearning: Emerging Standard Enables Accessibility, Interoperability of Digital Content":

"The Sharable Content Object Reference Model--or SCORM--is a collection of standards and specifications adapted from multiple sources to allow for the interoperability, accessibility, and reusability of digital learning materials: everything from a video clip illustrating how cells divide to a PowerPoint explication of a sonnet.

The SCORM specifications are becoming increasingly important for ensuring that digital content can be integrated into any learning management system (LMS) software, regardless of its manufacturer. What's more, SCORM is opening the door for the creation of "digital repositories," or collections of sharable, reusable online content that educators can search through to find items they can incorporate into their own instruction."

Recommendation

This meta research study only scratches the surface of the transformation underway. In order to save the great wealth represented by the industry and the many lives and careers affected by the transformation, a large scale study should be implemented quickly where the appropriate longitudinal data can be collected and analyzed, and strategies developed to chart a roadmap for navigating the transformation.

About the Author

Paul Schumann is a futurist and an innovation consultant. He is the founder and current president of the Central Texas Chapter of the World Future Society (www.centexwfs.org). He is the president of Glocal Vantage Inc. (www.glocalvantage.com) and The Innovation Road Map (www.theinnovationroadmap.com). He is a member of the advisory boards of the Marketing Research Association (www.mra-net.org) and ACC's Center for Community-based and Nonprofit Organizations (www.nonprofitaustin.org). He is also active in Texas Forums (www.texasforums.org).

Paul is leading an international volunteer effort to understand the principles of a successful innovation commons through the Innovation Commons Network. He has coauthored two books and has written numerous articles and book chapters. He writes extensively on the web

on four blogs – <http://innovationtravelogue.blogspot.com> , <http://centexwfs.blogspot.com> , <http://illuminatedinnovant.blogspot.com> and <http://innovationcommons.blogspot.com> .

Prior to forming Glocal Vantage, Inc., he had a 30 year career with IBM as a technologist and technology manager in semiconductors, an internal entrepreneur creating the first independent business unit in IBM, and a cultural change agent. He has BS and MA degrees in physics from the University of Texas. His current interests are in understanding the power of media to shape how we perceive and think about the world, and in extreme democracy, and other applications, that utilize the power of social technologies to facilitate change.